July 31, 2018

Byron:

As follow up to our phone call yesterday, we would like to make two requests:

First, if possible, could you provide a summary of the testing you performed on the BMW vehicle(s)? We are interested to know the Model, Model Year, and the conditions under which the testing was performed.

For our investigation we tested a MY 2012 BMW X5 xDrive335d with approximately 60,000 miles on it. We think it's reasonable to test vehicles approximately mid-way through their useful life as it doesn't bias the results either too far toward a new system or too far toward a heavily aged system. The BMW X5 shares a common engine platform with the 335d with the only difference being the X5 employs both high and low pressure EGR loops, while the 335d used high pressure EGR only. We know that BMW changed from the M57 platform to the N57 platform in model year 2014, in which case a NOx adsorber catalyst to the suite of emission control systems.

The attached document is the complaint filed by our client which lists additional information for the vehicle we tested. Section 4 contains details on the testing and test results. Key findings where excessive emissions occurred:

1. Cycle awareness: Simulating FTP phase 2 cycle on flat ground shows emissions compliance, while driving an arbitrary cycle comprised of similar speeds and accelerations shows factor of 10 or more increase in NOx. This test has been repeated many times and the results are highly consistent. These phase 2 NOx emissions have been verified both on the chassis dyno with an official FTP-75 and on the road. Using proprietary driver's trace software, we can drive emissions cycles on the road. In this case, our on-road FTP-75 phase 2 emissions are nearly identical to those measured on the dyno, which we feel is a strong validation of the representativeness of the PEMS testing on the road. However, when we change to an arbitrary cycle on the road with similar relative positive accelerations and average speed, the emissions increase by a factor of 10 and well above the standard. The result is that, in FTP-like conditions, the vehicle is many times the standard in a wide variety of very common conditions (flat road, moderate ambient temperatures, etc).

We also found the hot and cold start emissions to be much higher than those found during testing on the dynamometer across a wide variety of conditions.

2. Temperature window: High emissions (factor of 2-7 increase over standard) when ambient temperatures drop blow 68°F. We might presume an AECD would be approved for adjustments in ambient temperature. However, were the derated SCR dosing and the significant resulting increases NOx also disclosed?

3. Road grade: Increased emissions on road grade. As grade increases, both EGR and SCR are reduced with large increases in NOx. We understand while driving on a grade the engine works harder and emissions should increase, but not at these levels. Our thinking is that outside the load and speed points of the FTP, the manufacturer feels comfortable to derate both the SCR and the EGR in ways that are not technically justified, with resulting NOx increases that are unreasonably high.

These findings are discussed in detail in the complaint. As you pointed out, we do not have the benefit of knowing what AECDs were presented and approved. However, we believe the full emissions impact and frequency at which AECD enabled operation were likely not disclosed. We had the opportunity to examine the AECD disclosures in our Mercedes case, for example, before filing the case. The AECD disclosures for ambient temperature adjustments to the emission control system made an argument that the effect on NOx would be small. We show in that case, however, that the emissions increase by several factors. We also use our own engineering judgement and the judgement of other experts with considerable OEM experience about whether the magnitude and impacts of the adjustments are justified.

One last point, to rule out degradation or other factors, we tested the same vehicle on a chassis dynamometer, where emission values were either near or below the standard.

Second, could you provide us with a statement on the validity of PEMS testing? While we fully understand PEMS is only one of a suite of tools needed to evaluate the presence of defeat device, it is a critical and proven tool. If operated properly under a well-designed test protocol it yields useful information that cannot be gathered in any other way.

PEMS has been used by many organizations to look at real world emissions behavior and it has been central in all the recent studies and cases related to defeat devices. Examples where PEMS has played a key and primary role in examining real world emissions for comparison to certification values, include West Virginia University, TUV, and CARB. As you are aware, of course, it's also being used for RDE in Europe and for countless European studies detailing the real-world emissions problems with the fleet of European passenger cars.

In fact, CARB just announced a recall of Cummins Heavy-Duty trucks to replace a defective SCR catalyst. The announcement touts this action of the first major recall resulting from in-use testing **using PEMS**. See link for more details.
(http://www.greencarcongress.com/2018/07/20180731-arb.html >

You should be aware that we are using PEMS in a highly sophisticated way with very carefully controlled conditions that account for, among other things, road grade, ambient temperature, speed profiles, and acceleration rates. We are using PEMS in conjunction with sophisticated OBD loggers in order to collect engine and emission control system operational data. We collect and analyze dozens of engine parameters along with our PEMS data in order to interpret how the emission control system and engine are operating. Furthermore, we conduct chassis dynamometer testing certification tests to help supplement the overall dataset in order to

demonstrate vehicle compliance on the official certification cycles. We are careful to control our on-road PEMS testing so that it is directly comparable to what we find on the dyno.

Third, it would be helpful if your agency could find a way to soften the impact of that article's statement about our qualifications, which we believe to be totally inaccurate.

The "Two men and a PEMS" comment, unfortunately, is now being used to undermine our credibility. This comment is quite simply inaccurate as applied to our consulting firm and cases. The forwarded article makes the statement that, "EPA Director Grundler said attorney Berman certainly did not have the expertise and laboratory technology available to the EPA." This comment is being touted as an official position by the EPA that we are not qualified. Given that EPA has never been given a statement of our firm's qualifications, our test capabilities, or our test procedures, this comment should never have been made. It is neither "two men," nor is it simply PEMS. This is counterproductive to our shared goal of ensuring that the US fleet of passenger cars and trucks actually meet the letter and intent of the strict emission standards.

Here is a short write up on 44 Energy and our team of engineers and consultants.

Juston Smithers, the lead investigator of this work is a degreed engineer and expert in chassis dynamometer and PEMs testing with over 15 years of experience in designing and testing diesel emissions control systems. Many Executive Orders have been granted by CARB based on chassis dynamometer testing performed by Juston. Co-investigator Brad Edgar, has a Ph.D. in Mechanical Engineering with 25 years of experience in diesel emissions control systems and a recipient of the prestigious Haagen-Smit award from CARB for achievements in clean air technology. According to CARB's release accompanying the award, the co-investigator, "has pioneered important breakthroughs in developing advanced technologies to reduce diesel particulates and oxides of nitrogen." Furthermore, he has "earned a reputation as an industry leader helping to deploy the technology needed to keep California's air clean." Brad also sits on the advisory board for UC Berkeley's mechanical engineering department.

We are named on numerous US patents for inventions related to diesel emission control systems. In addition, our efforts have been assisted by other qualified professionals with extensive OEM and regulatory experience specific to the field of diesel emission control systems. We employ a staff of test engineers to operate our three PEMS systems and oversee chassis dynamometer testing. We have a number of consultants that work for us in various capacities. We contract with 3 former OEM calibration, testing, and development engineers and former highly placed CARB staff member. We leverage our many contacts at the Air Resources Board, work with UC Riverside/CE-CERT, UC Berkeley, Transportation Research Center, and Sensors Inc (the manufacturer of our three PEMS systems). And, of course, we have made good-faith efforts to share our findings with EPA staff.